

Claims

- [c1] 1. An electrochemical cell, comprising:
a first electrode and a second electrode with a membrane disposed therebetween and in ionic communication with the first electrode and the second electrode;
and
a sintered porous support member disposed on a side of the membrane opposite the second electrode, wherein the support member comprises a first portion on first side of the support member proximate the membrane and a second portion disposed on a side of the first portion opposite the membrane, wherein the second portion has a second portion porosity different from a first portion porosity.
- [c2] 2. The electrochemical cell of Claim 1, wherein the second portion porosity is greater than the first portion porosity.
- [c3] 3. The electrochemical cell of Claim 2, wherein the first portion porosity is less than or equal to about 60%.
- [c4] 4. The electrochemical cell of Claim 3, wherein the first portion porosity is about 35% to about 50%.

- [c5] 5. The electrochemical cell of Claim 2, wherein the second portion porosity is greater than or equal to about 50%.
- [c6] 6. The electrochemical cell of Claim 5, wherein the second portion porosity is about 50% to about 70%.
- [c7] 7. The electrochemical cell of Claim 1, wherein the support member comprises a third portion disposed on a side of the second portion opposite the first portion, wherein the third portion has a third portion porosity that is less than or equal to the second portion porosity.
- [c8] 8. The electrochemical cell of Claim 1, wherein the support member comprises a plurality of layers, wherein each layer has a layer porosity of greater than or equal to a previous layer.
- [c9] 9. The electrochemical cell of Claim 1, wherein the support member is a single layer comprising a decreasing porosity gradient from the first side toward a second side disposed opposite the first side.
- [c10] 10. The electrochemical cell of Claim 1, wherein the support member further comprises a second side comprising a channel.
- [c11] 11. The electrochemical cell of Claim 10, wherein the

channel extends from an inlet disposed proximate an edge of the side to a terminus disposed proximate a geometric center of the side.

- [c12] 12. The electrochemical cell of Claim 10, wherein the channel extends from an inlet disposed proximate an edge of the side to an outlet disposed proximate the same or a different edge of the side.
- [c13] 13. The electrochemical cell of Claim 1, wherein the second portion comprises higher porosity regions and lower porosity regions.
- [c14] 14. The electrochemical cell of Claim 1, further comprising a pressure pad disposed in physical and electrical communication with the support member.
- [c15] 15. The electrochemical cell of Claim 1, further comprising an additional sintered porous support member disposed on a side of the membrane opposite the support member.
- [c16] 16. The electrochemical cell of Claim 15, wherein the additional support member comprises the second electrode.
- [c17] 17. The electrochemical cell of Claim 15, wherein the additional support member further comprises a first addi-

tional portion on first side of the additional support member proximate the membrane and a second additional portion disposed on a side of the first additional portion opposite the membrane, wherein the second additional portion has a second additional portion porosity different from a first additional portion porosity.

- [c18] 18.The electrochemical cell of Claim 17, wherein the second additional portion porosity is greater than the first additional portion porosity.
- [c19] 19.The electrochemical cell of Claim 1, wherein the support member further comprises the first electrode.
- [c20] 20.An electrochemical cell, comprising:
a first electrode and a second electrode with a membrane disposed therebetween and in ionic communication with the first electrode and the second electrode;
a flow field consisting essentially of a sintered porous support member disposed in electrical and physical communication with the first electrode; and
a pressure assembly disposed in physical and electrical communication with the flow field.
- [c21] 21.The electrochemical cell of Claim 20, wherein the support member further comprises a first portion adjacent the membrane and a second portion on a side of

the first portion opposite the membrane, and wherein the second portion has a second portion porosity different from a first portion porosity.

- [c22] 22.The electrochemical cell of Claim 20, wherein the second portion porosity is greater than the first portion porosity.
- [c23] 23.The electrochemical cell of Claim 20, wherein the support member further comprises the first electrode.
- [c24] 24.The electrochemical cell of Claim 20, wherein the support member is configured to support the membrane at pressures of greater than or equal to about 100 psi.
- [c25] 25.The electrochemical cell of Claim 24, wherein the pressures are greater than or equal to 500 psi.
- [c26] 26. The electrochemical cell of Claim 20, wherein the porous support member comprises a channel.
- [c27] 27.The electrochemical cell of Claim 20, wherein the pressure pad assembly is a pressure pad.
- [c28] 28.A method for operating an electrochemical cell, comprising:
 - passing water through a sintered porous support member to a first electrode;
 - producing hydrogen ions and oxygen;

moving the hydrogen ions across a membrane to a second electrode, wherein there is a pressure differential across the membrane of greater than or equal to about 100 psi; and
forming hydrogen gas at the second electrode;
wherein the support member is disposed on a side of the membrane opposite the second electrode, wherein the support member comprises a first portion on first side of the support member proximate the membrane and a second portion disposed on a side of the first portion opposite the membrane, and wherein the second portion has a second portion porosity different from a first portion porosity.

- [c29] 29.A method for operating an electrochemical cell, comprising:
passing water through a flow field to a first electrode;
producing hydrogen ions and oxygen;
moving the hydrogen ions across a membrane to a second electrode, wherein there is a pressure differential across the membrane of greater than or equal to about 100 psi; and
forming hydrogen gas at the second electrode;
wherein the flow field consists essentially of a sintered porous support member disposed in electrical and physical communication with the first electrode, and wherein

a pressure assembly is disposed in physical and electrical communication with the flow field.